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The Effect of Externally Applied and Self-Excited Waves on Relativistic Electrons

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A series of experiments is underway to explore the effect of both self-excited and externally launched plasma waves on relativistic electrons (REs) across a wide range of geometries and plasma parameters. While O and X-mode waves are routinely used for heating and current-drive in tokamaks they are incapable of directly resonating with REs since their phase velocity is much greater than the speed of light. However, on the DIII-D tokamak it has been observed that when EC waves are launched into the low density quiescent runaway electron (QRE) regime the RE population is expelled on a 100ms time-scale. It is hypothesized that this flushing is due to a transition to a new turbulence regime and therefore increased RE transport. Recent experiments exploring this effect measured for the first time an increase in low frequency (<200kHz) density and magnetic fluctuations whose amplitude correlates with increased RE flushing as the ECH power is increased (Figure 1). A series of experiments is also planned through the Frontier Science Program to study the effect of both externally injected and self-excited plasma waves on REs. Experiments are planned to explore the effect of externally launched Whistler waves on REs in the LArge Plasma Device (LAPD) linear device. Experiments are also planned on the Madison Symmetric Torus (MST) which is equipped with a high frequency probe capable of measuring waves up to 6GHz. This provides a unique opportunity to measure self-excited waves up to and approaching the EC frequency as well as measure the RE-driven slow-X EC wave due to the ability to insert this probe directly into the plasma.

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